RADIO SKY MAPS

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The two radio sky maps presented in this note were copied from the Proceedings of the IEEE, April 1973. The temperature contours plotted on these maps tell an observer where the hot (noisy) and cold (quiet) areas of the sky are located. This information is useful to a moonbounce operator because, if the moon is in front of a hot spot, the radio frequency radiation may mask or completely override any echoes. Also, those amateurs who want to check out antenna gain, or receiver noise figure, may want to find a hot spot to use as a signal source.

The radio sky maps use for their coordinates, Right Ascension and Declination. Most moonbouncers have an understanding of Declination, but Right Ascension is normally not used. The Nautical Almanac and most of the computer and calculator programs presented in the EIMAC EME notes use GHA, or Greenwich Hour Angle. The main difference between the two systems is the starting reference point. Astronomers use the Right Ascension and Declination system, whereas navigators tend to use Greenwich Hour Angle and Declination.

Greg Roberts, ZS1BI, a professional astronomer in Observatory, South Africa, was asked if he would explain the method for converting the Nautical Almanac GHA data into R. A. (Right Ascension). Greg's contribution follows:

> I was most interested in the radio sky maps, especially the one for 136Mhz as this is covered by my satellite tracking equipment. I gave your request some thought and I think my solution is as easy as they come. I will do a sample calculation in some detail so that anyone should be able to follow it... I hope.
>
> Problem: Determine the Right Ascension (R. A.) and Oeclination (Oec) of the moon, using only the Nautical Almanac.
>
> Approach: Select the data and time for which the data is required. Let us suppose it is October 31, 1979 at 09hr GMT (or UT). From the Nautical Almanac for 1979, we find for this date that the Greenwich Hour Angle (GHA) of the moon is 187 degrees 51.8 minutes, whilst the Dec is 6 degrees 40.6 minutes south. For intermediate times, eg 9hr 30 min, interpolate in the tables given.
>
> Method:
>
> 1. Convert GHA to hours and minutes decimal minutes as follows
>
>   (i) convert minutes of GHA to decimal degrees
>
> $$\text{eg} \quad \frac{51.8}{60} = 0.86333$$
>
>   (ii) convert GHA, which is now 187.86333 degrees, to hours decimal hours as done by
>
> $$\frac{187.86333}{360} * 24 = 12.524222 \text{ hours}$$
>
>   (iii) convert decimal part to minutes decimal minutes
>
> $$\text{eg} \quad 0.524222 * 60 = 31.453 \text{ minutes}$$
>
>   Hence GHA as hours minutes decimal minutes is 12 hr 31.453 minutes.

2. Determine the day of year corresponding to October 31.

   For 1979, January = 31, Feb = 28, March = 31, April = 30, May = 31, June = 30, July = 31, August = 31, Sept = 30 and Oct = 31.
   The total of all this is 304 days.
   (Don't forget a leap year has 29 days in Feb !)

3. Compute the sidereal time at Greenwich for the Universal Time and day chosen, eg sidereal time at Greenwich for October 31, 1979 at 09 hours UT.

   The formula to use is

   Sidereal Time (S.T.) = constant +1.0027379 *T + 0.06570982 *0

   where the constant is selected for the particular year (the constant is actually the sidereal time for January 0.0 of the year involved), and is in hours decimal hours, T is the time required for, again in hours, and D is the year day. Substituting we get

   S.T. = 6.604441 + 1.0027379 * 9 + 0.06570982 * 304

   = 6.604441 + 9.024641 + 19.975785

   = 35.604867

   Express this in the range 0 to 24 hours by subtracting 24 hours and we get

   Sidereal Time required = 11.604867 hours.

   Convert the decimal part to minutes decimal minutes as follows:

   0.604867 * 60 = 36.292 minutes

   Thus S.T. is 11 hours 36.292 minutes

4. Oetermination of R.A. of Moon

   R.A. = Sidereal Time - Greenwich Hour Angle

   = 11 hrs 36.292 min - 12 hrs 31.453 min

   Since this would give a negative R.A., ADD 24 hours to the sidereal time, hence

   R.A. = 11hr 36.292min + 24 hr 00 min - 12 hr 31.453 min

   = 35 hr 36.292 - 12 hr 31.453 min

   = 23 hr 04.839 min

Conclusion:
We thus find for October 31, 1979 at 09 hrs GMT, that the position of the moon is

R.A. 23 hours 04.839 minutes
Oec. 6 degrees 40.6 minutes south

The Astronomical Ephemeris for 1979 give the position of the moon as

R.A. 23 hours 04.800 minutes
Oec. 6 degrees 40.7 minutes south

The answer is thus satisfactory.

Note that the determination of the R.A. of the moon is INOEPENOENT of your longitude and latitude and Part 3 is the only "complicated" part.

CONSTANT TO BE USEO FOR VARIOUS YEARS:

1978	6.620418	1982	6.622408
1979	6.604441	1983	6.606493
1980	6.588527	1984	6.590579
1981	6.638322	1985	6.640374

One could work in hours decimal hours and forget about converting to minutes decimal minutes etc. We then have:

1.(ii) GHA = 12.524222 hours

3. S.T. required = 11.604867

4. R.A. = 11.604867 - 12.525222 = -0.919355

A00 to 24 hrs. and we get

R.A. = 23.080645 hours

or R.A. =(11.604867 + 24.0000) - 12.524222

= 35.604867 - 12.524222

= 23.080645 hours

Converting to minutes decimal minutes we end

with R.A. = 23 hours 04.839 minutes

You might want to point the EME array at a selected R.A. and Oeclination, and for this you need the GHA. Using the same equations in the proper manner, it is possible to calculate the equivalent GHA and Oeclination.

Well, that's it. There are other refinements that could be introduced, but I do not consider them necessary in this case since the accuracy with which one can plot the moons position on the charts is limited by the scale of the charts, and with the moon about half a degree in diameter, a small error does not matter. Also I note that the year in which the chart was plotted is not given. Oue to precession there will be a slight displacement in R.A. and Oec. of the contour lines, but here again the shift is small enough to ignore for our purposes.

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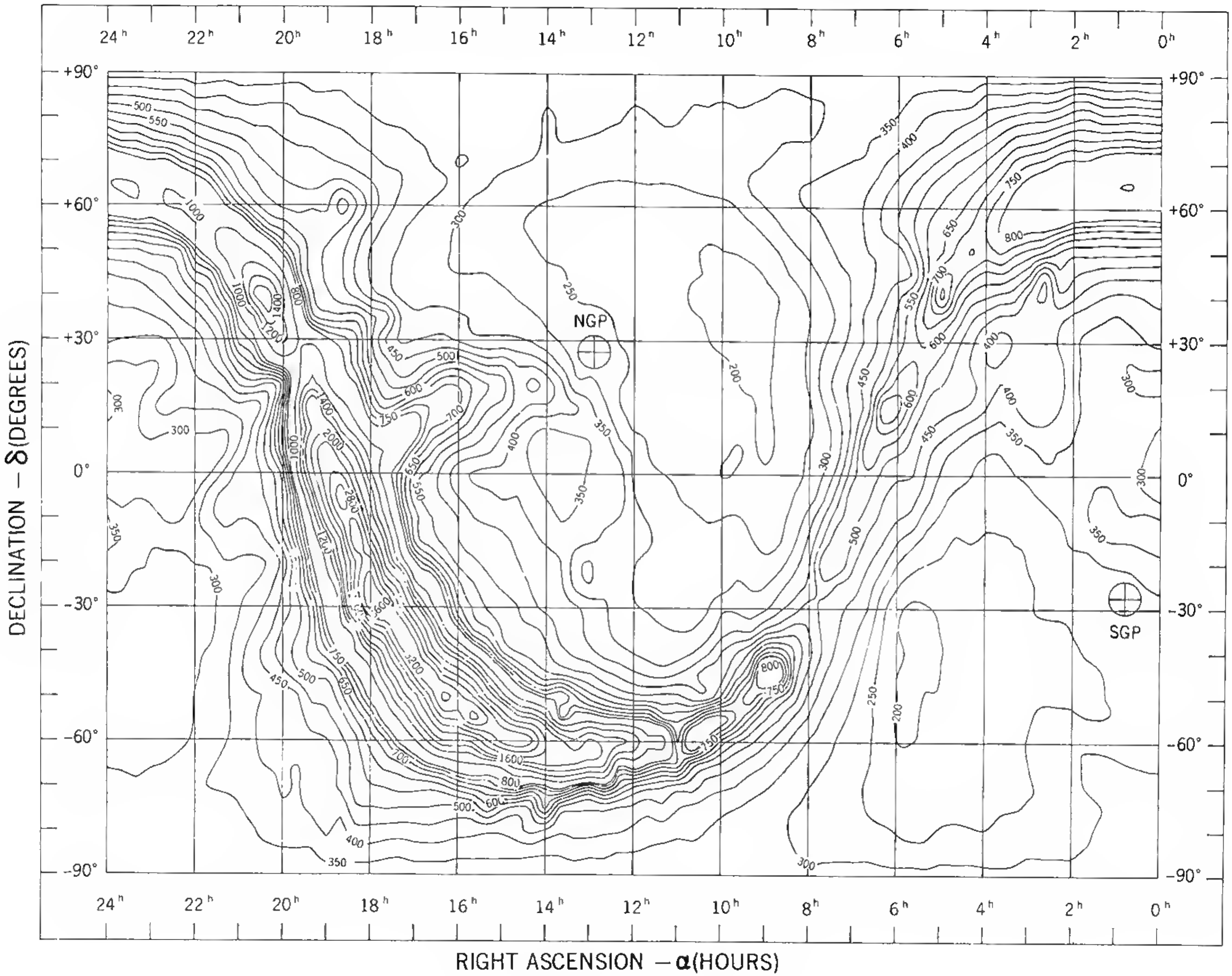
The asterisk appearing in Section 3 is the symbol used by computer programmers to denote multiplication.

Those amateurs using a computer program such as the one written by Lance Collister, WA1JXN, the Right Ascension is calculated within the program and converted to GHA for print out. The program can be changed to print out the R.A. along with the GHA. This feature would be useful with the radio sky map.

For determining the day of the year as in Section 2 of Greg's write-up, the Nautical Almanac has a table near the front of the book which gives this information.

Every month in the "Sun, Moon, and Planets This Month" section of the Sky and Telescope Magazine there is a sky map with the moon position plotted for several days of the month. The X-axis of this map is Right Ascension in hours. Therefore, with this map and the radio sky map, it is possible to determine if the moon is in front of a quiet or noisy part of the sky. Incidently, the Sky and Telescope Magazine also is a good source for predicted meteor shower activity and the expected peak days.

136 MHz BRIGHTNESS TEMPERATURE (KELVIN)



400 MHz BRIGHTNESS TEMPERATURE (KELVIN)